IN THE SPECIFICATION

Please amend the substitute specification to replace paragraphs numbers 4, 6, 7, 9, 11, 12, 20, 21, 22, 23, 25, and 26. The full text of the replacement paragraphs with markings to show changes is presented as follows:

REPLACEMENT PARAGRAPH WITH MARKINGS

(4) However, in some magnetrons, oscillations may occur simultaneously in the desired $\underline{\pi}$ mode and also in the unwanted π-1 mode despite the use of strapping, resulting in frequency instability and power being lost from the π mode to the π-1.

(6) According to the invention, there is provided a magnetron comprising: an anode having resonant cavities and coaxially arranged with a cathode about a longitudinal axis; output means including a coaxial line configured to receive energy in one oscillator ~~made~~ mode and transmit it as a coaxial transmission mode and to receive energy in another oscillator mode and transmit it as a cylindrical waveguide mode; and means for at least reducing onward transmission of energy in the cylindrical waveguide mode.

(7) Use of the invention enables energy in the undesired oscillator mode to be removed from the resonant cavities in addition to the energy in the desired mode and subsequently separated from the desired mode energy. Thus, power in the unwanted oscillator mode within the magnetron is reduced, tending to enhance operation in the desired mode and improving frequency stability and ~~powere~~ power output. The invention is particularly advantageously applied where the anode is long, for example, where the anode has an axial length of greater than half wavelength ($\lambda/2$) where λ is the operating wavelength. For such long anodes, conventional strapping at the ends of the anode may be ineffective in maintaining the required mode separation. In addition, because a long anode allows high power levels to be achieved, in the absence of the invention significant

amounts of energy would exist in the unwanted oscillator mode reducing power output in the wanted mode.

(9) Advantageously, the coaxial line has at least one axially extensive slot through its outer conductor via which energy in the cylindrical waveguide mode is coupled from the coaxial line. In a coaxial transmission mode, the voltage is radial and the current travels in an axial direction whereas in a cylindrical waveguide mode, the currents are circumferential. Thus, the use of an axially extensive slot will not interfere with power transmission in the coaxial waveguide mode but will intercept current in the cylindrical waveguide mode. Advantageously, radiation absorbing material is located at ~~said~~ the at least one slot to absorb energy radiated by the slot. Only one slot may be provided but it has been found that four slots located equidistantly around the outer conductor and located at the same position along the axis give particularly good performance. In one embodiment, the absorbing material is porous alumina impregnated with carbon. Longer slots tend to give greater energy absorption and a larger mass of absorbing material may be used to give greater capacity for absorption.

(11) In an advantageous embodiment, there is included at least one axially extensive reflector slit in the output means for reflecting energy from said another oscillator mode back towards the resonant cavity. Thus energy in the cylindrical waveguide mode is coupled back to the resonant cavities. The reflector slits have no effect on the π mode as it is transmitted in the TEM mode in which the currents flow axially. However, the π-1 mode couples to the coaxial line in the TE_{11} mode having circumferential currents which

are affected by the reflector slit or slits. By appropriately selecting the length and location of the slits, some of the TE_{11} mode is reflected in a reverse direction along the coaxial line at a phase and magnitude determined by the slit geometries, increasing its coupling to the π-1 mode in the anode. This gives increased loading of the π-1 mode, resulting in more stable operation of the magnetron, permitting it to operate over a wider range of input conditions and to be more tolerant of output and input conditions.

12) The reflector slit or slits may be in the outer conductor of the coaxial line, the inner conductor or in both. Where the slits are in the inner conductor of the coaxial line, in one preferred arrangement, the slit is extensive through the inner conductor, that is, it extends from one surface to the other. Advantageously, there are two reflector slits in the inner conductor which are both extensive therethrough and which intercept <u>each other</u>. In one embodiment, a reflector slit or slits may be located such that they are located partially or wholly in a region between the resonant cavities and the end of the coaxial line nearest the anode.

(20) The output of the magnetron is coupled in an axial direction from the bottom of the anode 2 as viewed. Alternate anode vanes are connected via fingers, two of which 11 and 12 are shown, to a plate 13. The plate 13 is connected to a conductive member which forms the inner conductor 14 of a coaxial output line 15. ~~the~~ <u>The</u> outer conductor 16 of the coaxial line is defined by a copper member which is located in a recess in one of the pole pieces 10. The outer conductor 16 has four equidistant slots, two of which 17 and

18 are shown, which extend through the outer conductor 16. ~~a~~ A cylindrical attenuator 19 of radiation absorbing material, which in this case is carbon impregnated alumina, surrounds the outer conductor 16. The end of the coaxial line 15 terminates in a T probe 20 which projects into a rectangular waveguide 21.

(21) Further detail of the coaxial output line 15 is shown in figure 2. The inner conductor 14 is surrounded by the outer conductor 18 in a coaxial manner. The outer conductor ~~18~~ 16 includes slots 17, 18 for providing attenuation as described later. An attenuator 19 of radiation absorbing material surrounds the outer conductor 18 within a pole piece 10. The inner conductor ~~17~~ 14 has a diameter 'a' less than the diameter 'b'of the outer conductor 18.

(22) During operation of the magnetron, oscillations are generated in the resonant cavities in the anode and energy is generated in the π and π-1 oscillator modes. Energy in the π mode is coupled into the coaxial output line 15 via the fingers 11 and 12, the coaxial line 15 having dimensions such that the π mode energy is transmitted along it in the TEM coaxial transmission mode. The coaxial line 15 is dimensioned so that it is also able to support and transmit energy from the π-1 oscillator mode in a cylindrical waveguide mode, the TE_{11} waveguide mode. Figure 3 illustrates the TEM mode in which the direction of the currents is shown by the broken lines and that of the electric field by the solid line. Figure 4 shows the current and electric fields for the TE_{11} mode. As can be seen in Fig. 3, in the TEM mode, the currents travel in an axial direction and thus transmission of energy along the coaxial line 15 in the TEM mode is not affected by the presence of the axially extensive slots 17 and 18 in the outer conductor 16. In

contrast to this, currents in the TE_{11} mode in Fig. 4 travel in the inner and outer conductors in a circumferential direction. The circumferential currents are intercepted by the slots 17 and 18, resulting in energy being coupled therethrough and being radiated towards the absorbing material 19. By this mechanism, energy is transmitted along the coaxial line 15 in both the TEM and TE_{11} modes but energy in the TE_{11} mode is absorbed such that the amount transmitted is reduced or it is completely attenuated. Thus the energy coupled into the waveguide 21 by the probe 20 is substantially only that which was generated in the π mode oscillation. The output energy is transmitted in the direction shown by the arrow along the waveguide 21.

(23) As shown in Fig. 1, [The] the asymmetric nature of the transition 20 results in some of the TEM mode energy being reflected and re-transmitted along the coaxial line 15 in a reverse direction towards the anode 2, being converted to a TE_{11} mode on reflection. A discontinuity 22, which in this case comprises a reduction in diameter of both the inner conductor and the outer conductor, ensures that energy in the TEM mode that is converted to energy in the TE_{11} mode cannot travel beyond the discontinuity 22. Thus it does not impinge on the absorbing material 19 and add to the energy which it must absorb.

(25) In addition to the coaxial line 15 included in the output of the magnetron, a second coaxial line 25 is axially located on the side of the anode to which connection is made to the cathode 1. The inner conductor 26 of the second coaxial line 25 is provided by the tube 8 and the outer conductor 27 is defined by an insert located in a recess in the

iron pole piece 9. The outer conductor has four slots, two slots 28 and 29 being shown, arranged around ~~it~~ the outer conductor and is surrounded by a cylindrical member of radiation absorbing material 30. The dimensions of the second coaxial line 25 are the same as that of the coaxial line 15 in the output but because there is not the direct coupling from the alternate anode vanes, only a very small proportion of energy in the π mode is coupled into the second coaxial line 25. However, [it] the second coaxial line does receive energy from the π-1 mode which is transmitted along it in the TE_{11} waveguide mode. The energy is coupled via the slots 28 and 29 to the absorbing material 30 where it is absorbed.

(26) Reflector slits may also be included on the cathode lead side of the magnetron if desired and [there] these reflector slits operate in a similar manner to [those shown at] slits 23 and 24, although for mechanical reasons, in this location the reflector slits would be more conveniently located in the outer conductor of the second coaxial line 25.